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Floating wind turbines off California coast soon could boost power grid

Wind turbines are pictured on the first French offshore wind farm off the coasts of La Turballe, western France on September 30, 2022. California wants to add as much as 5,000 megawatts of offshore wind power by 2030. (Photo by DAMIEN MEYER/AFP via Getty Images)

New state and federal programs are expected to trigger a surge in offshore wind energy projects. But don't expect to see turbines from the Southern California coast.

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Fly into Amsterdam and, just before landing, you'll pass over row after row of bright white wind turbines sprouting up from the North Sea.

With offshore wind stronger and more consistent than wind on land, climate-minded European governments have been subsidizing clean energy offshore wind farms since the 1990s. There are now 123 such farms off the coast of 13 European countries, according to data from WindEurope.org. Those farms are home to nearly 6,000 turbines capable of generating 28,363 megawatts of power, which meet 3% of Europe's energy needs.

Southern Californians are accustomed to seeing wind turbines lining the hills off the 10 freeway in the Coachella Valley. But offshore farms are rare. Just two have come online in the United States, with five turbines off the coast of Rhode Island and two near Virginia able to produce 42 megawatts of fossil-free electricity for nearby residents.

And though California has almost twice as much coastline as the Netherlands, where nine large offshore wind farms are drumming up energy around the clock, no wind farms have been developed yet along the coast of the Golden State.

To date, offshore wind energy in the United States has been held back by a combination of high costs, lack of government support and, along the West Coast, geography.

But with wind power now seen as key to helping both California and the U.S. meet their clean energy goals, new state and federal programs are focused on helping us push past those obstacles and become a leader in the offshore wind front.

A wind turbine generates electricity at the Block Island Wind Farm on July 07, 2022 near Block Island, Rhode Island. It became the first commercial offshore wind farm in the United States when the five-turbine project was developed by Deepwater Wind and began operations in December, 2016 at a cost of nearly $300 million. (Photo by John Moore/Getty Images)

In August, the California Energy Commission set goals of installing offshore wind projects that could generate 2,000 to 5,000 megawatts by 2030 and 25,000 megawatts by 2045. That would be enough electricity to power 3.75 million homes over the next seven years and 25 million homes by mid-century.

Then, in September, the Biden Administration announced it was expanding earlier offshore wind energy goals with incentives specifically aiming at bolstering deep water projects.

Wind turbines can be anchored to the sea floor in shallow waters off Europe, most of the East Coast and the Gulf of Mexico. But two-thirds of America's offshore wind energy potential lies in deeper waters, such as the steep continental shelves found a few miles off the West Coast and the Gulf of Maine. Once water gets deeper than 60 meters, fixed-bottom platforms become impractical and costly. Instead, wind turbines must be mounted on floating platforms anchored to the seabed with flexible mooring lines and chains.

If offshore wind farms were built in every body of water where wind speeds make such projects viable, the Department of Energy estimates that those projects alone would generate twice as much total energy as the United States now produces.

Engineers still are working to make floating offshore wind structures more stable and cost effective, though. That's why no commercial-scale floating offshore wind power projects have been built in the United States to date. Globally, just 100 megawatts of floating offshore wind has been deployed, including three commercial farms in the United Kingdom and Portugal, vs. more than 50,000 megawatts of fixed-bottom offshore turbines.

But with new goals and incentives in place, California soon could be home to the nation's first two commercial floating wind farms. Windy stretches of open ocean off the coast of Morro Bay and Humboldt are going to auction in late fall, for lease to interested wind farm developers.

That doesn't mean Southern California's coastal waters will be dotted with turbines. "Once you go south of the Channel Islands, the wind energy resource drops off rapidly," said Walt Musial, an engineer heading up the offshore wind program at the National Renewable Energy Laboratory in Colorado. While those lighter winds, along with military interests and heavy port traffic, mean Southern California's coast isn't prime real estate for offshore wind projects, there is a chance some farms could one day be located several miles offshore, where winds are a bit stronger.

And as offshore wind farms come online further up the coast of California, it means a new source of relief for everyone reliant on the Golden State's strained energy grid is on the horizon.

From wind to electricity

To generate power, offshore turbines are placed facing into the wind. Those winds spin three steel blades, which feed a generator at the top of the tower that creates electricity. Wires take that power down the tower, then over to a nearby substation. The offshore substation collects power from all turbines in the farm and feeds it to an onshore substation, which is connected to the local power grid.

As turbines keep getting taller and their blades keep getting longer, they also are generating more energy, which makes them more cost effective. When the first offshore wind farm in the United States came online, in 2016 off the coast of Rhode Island, its towers were 150 meters high and could each generate 6 megawatts of power. Today, GE is deploying a turbine that's 260 meters tall, with blades longer than a football field, that can generate 12 megawatts of power. And a Chinese company says it plans to make a 16 megawatt turbine available by 2024.

So far, offshore wind projects — both floating and fixed-bottom — use the same turbines as onshore wind farms. It's below the water's surface that things get complicated, with only 25% of project costs related to the turbine itself when it comes to floating projects.

Floating wind turbines are fixed to one of a few different types of floating structures, which are anchored to the seabed with cables. Each of those current designs has its challenges, Musial says. That's why engineers are working to potentially combine a few of those designs, or to develop something new that is stable, has a low profile and doesn't disrupt sea life.

While there are challenges, floating wind technology doesn't extend all the way to the sea bed, so it generally has less impact on marine life and ocean activities such as fishing. Floating structures also can capture stronger winds further out at sea, at depths up to 1,300 meters. And they can have less visual impact, with many deep water projects not visible from the coast.

There are maintenance advantages, too. Floating turbines can be built at port facilities, then stood up and hauled out to sea by boat, where they're hooked to waiting mooring lines. While minor maintenance can be done at sea, crews doing bigger repairs, such as replacing blades, can unhook the turbine from its mooring lines and tow it back to shore, where the work is much less risky.

Otherwise, work on offshore wind turbines is so dangerous that operators in Europe have started turning to virtual reality to safely train workers to fix a blade on a 100 meter-high wind turbine that's located 100 kilometers offshore in blustery winds.

Despite its advantages, floating offshore wind remains the most expensive energy source. Offshore wind costs $136 per megawatt hour, per the latest report from the U.S. Energy Information Administration, while hydroelectric power costs $64, onshore wind costs $40 and standalone solar costs $36. That's where government incentives aimed at improving efficiency come into play.

Incentives coming

Shortly after taking office in 2021, President Joe Biden announced plans to help incentivize deployment of 30,000 megawatts of offshore wind energy by 2030, with a goal to reach 110,000 megawatts by 2050. That would be enough electricity to power more than 10 million homes each year, while also avoiding 78 million metric tons of carbon dioxide emissions.

On Sept. 15, the Biden Administration announced the Floating Offshore Wind Shot. The project aims to drive down the cost of floating offshore wind technology by at least 70%, to $45 per megawatt hour of power. That would make it just a bit more expensive than onshore wind and cheaper than hydroelectric power. To get there, federal regulators are doling out nearly $50 million for research and development, with a goal to incentivize 15,000 megawatts of floating offshore wind, or enough to power 5 million homes, in deep ocean and lake waters by 2035.

That includes nearly $7 million in federal prize money for a contest (with applications open through Jan. 13) to optimize floating platform technologies and get them ready for wide-scale domestic manufacturing. Another $1 million will help get a network of West Coast ports ready to support offshore wind, while several million more is dedicated to studying impacts on bats, marine mammals and fishing activities.

Gov. Gavin Newsom in May 2021 announced he was opening the West Coast to offshore wind projects for the first time, with funding for upgraded ports, new staff, studies and public outreach. When Assembly Bill 525 was signed into law last fall, it required the California Energy Commission to set offshore wind goals by this summer. Next up, the commission must submit a strategic plan for offshore wind development by June 30, 2023.

Such moves have financial firms projecting that the United States will be second only to China in terms of deploying new wind power over the next decade, which could produce tens of thousands of jobs.

It also could generate or boost ancillary businesses. For example, building the offshore wind structures and blades is projected to add demand for more than 7 million tons of steel from U.S. factories. And for each major windfarm component, from turbine blades to subsea cables, the federal government expects one or two new U.S. factories to be built.

Some are already underway in places like New Jersey, where a $250 million factory is expected to come online in 2023.

Projects taking off

As for California, two areas off the coast of Humboldt and three areas near Morro Bay, totalling a combined 373,000 acres, have so far been identified as prime floating wind farm locations. If fully developed, the projects could generate 4,500 megawatts of electricity, or enough power for 1.5 million homes.

The Bureau of Ocean Energy Management expects to put leases for those five areas up to auction by the end of the year for companies that want to bid for the right to potentially develop wind farms there, according to agency spokesman John Romero. Earlier this year, eight offshore wind farm areas in New York and North Carolina were auctioned for a combined $4.7 billion. Some of the winning bidders included a Charlotte-based utility company and the U.S. renewables arm of the French oil company TotalEnergies.

After a winning bid is chosen, that firm then has up to five years to study the area and submit specific plans for the project it wants to build. After that, the plan must go through numerous regulatory agencies for approval before construction can begin. That lengthy process is why, though global energy consultant Wood Mackenzie predicts California will hit 2,400 megawatts of offshore wind power in the next decade, the firm predicts all of those projects will come online in 2030 and 2031.

Federal regulators identified the areas off Morro Bay and Humboldt after studying a wide range of factors, from wind speeds to environmental sensitivity to existing ocean uses, Romero said.

Much of California's coastline, particularly in Southern California, is now designated off limits for such projects by the Department of Defense. A study by NREL found that, given the Defense department's current perimeters, only 88,000 megawatts of wind power could potentially be installed off the California coast. But the report says another 428,000 megawatts are possible if the department allows wind projects in its exclusion zones.

Those zones were the department's "best assessment in 2017" of areas where wind projects "would jeopardize military testing, training and operations," said Steve Sample, executive director of the agency's Military Aviation and Installation Assurance Siting Clearinghouse. Since that time, Sample said the department has worked with BOEM and other stakeholders to find some compromises, including the area off Morro Bay that had been declared off limits.

"The Department fully supports offshore development off the coast of Northern California," Sample said, "and is working with BOEM and the state to support development that does not significantly degrade readiness."

To hit California's goal of 25,000 megawatts of offshore wind energy by 2045, Musial said the BOEM will have to identify more wind energy areas and hold more auctions in the near future.